United States Patent

Scales et al.

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[54] PROSTHETIC ACETABULAR DEVICES

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[51] Int. Cl.....A61f 1/00, A61f 1/24

[58] Field of Search.....3/1; 128/92 R, 92 C, 92 CA

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[57] ABSTRACT

A prosthetic acetabular device of generally hemispherical cup form has for cement fixation, a plurality of annular ribs formed around its outer surface, the ribs extending from a minor proportion of such surface. The ribs preferably are parallel to the cup rim, have undercut side walls, and have transverse passages to facilitate cement flow except for the rib nearest the cup rim. The device was initially designed for manufacture from plastics material, but in a subsequently preferred form is of metal with a liner cup of plastics material.

5 Claims, 6 Drawing Figures

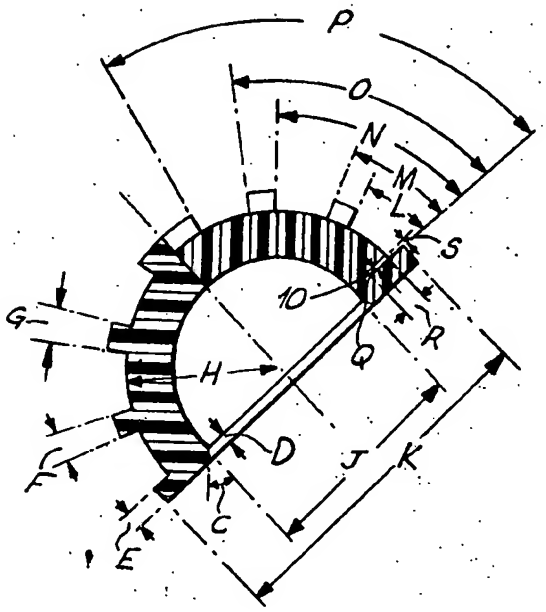


Fig. 1.

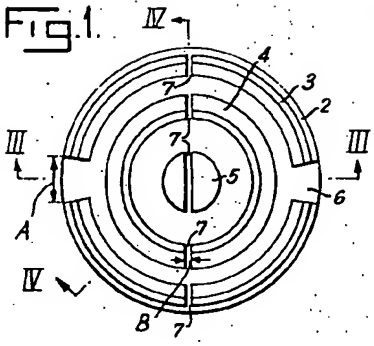


Fig. 2.

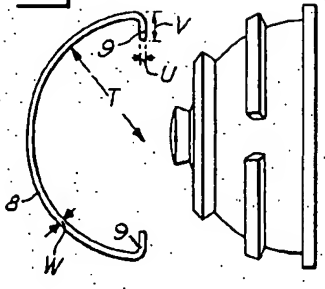
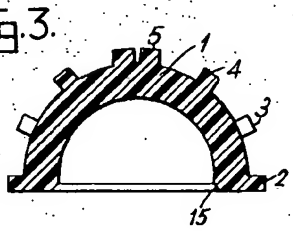


Fig. 3.



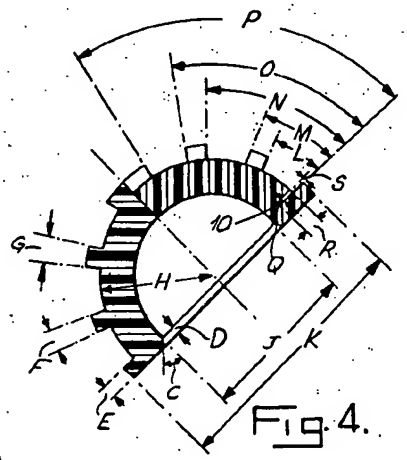


Fig. 4.

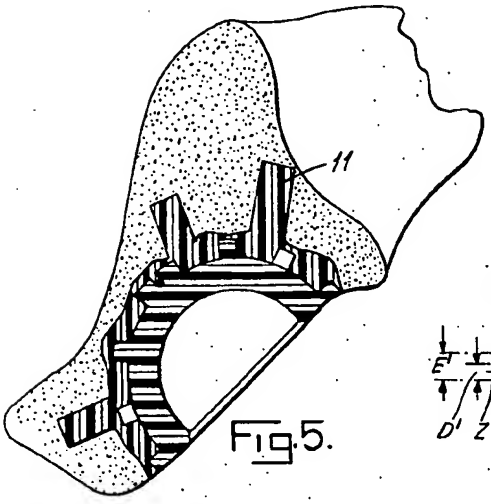


Fig. 5.

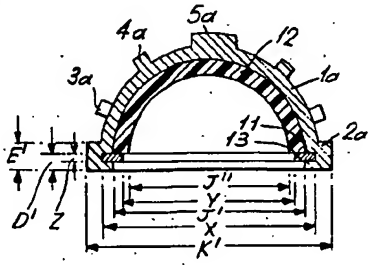


Fig. 6.

PROSTHETIC ACETABULAR DEVICES

This invention concerns prosthetic acetabular devices for use with currently available prosthetic femoral head devices in effecting hip joint replacements.

prosthetic acetabular devices are in fact already available in the form of generally hemispherical cups having grooves formed in their outer surfaces to key the devices into acrylic cement applied to suitably prepared acetabula. However, these known devices do not always prove satisfactory since the grooves only provide an entrant key into the cups over a small area relative to the total outer surface area of a given cup. Thus, if such a device is off-set by positioning closely adjacent one side of the prepared site, the result can be to squeeze away most of the cement over a significant area apart from any groove passing through that area. The area in question is then held by a relatively weak bond which can fail.

An object of the present invention is to reduce the possibility of this difficulty arising, and to this end there is provided a prosthetic acetabular device comprising a generally hemispherical cup having a plurality of annular ribs formed around its outer surface. The relevant point here is that the presently proposed device is ribbed, rather than grooved, to form a key and the ribs will serve as spacers between the cup proper and an implant site wall and so ensure that a major part of the cup surface and site wall are bonded by a satisfactory depth of cement. The ribs will in fact normally be of small transverse dimensions relative to the spaces therebetween, and will be normally at least 3 mm. high radially of the cup.

There are preferably at least three ribs including one adjacent the rim of the cup, and the ribs will be normally parallel to the rim. Also, the exterior surface of the cup is preferably provided with an elevated disc or end stop remote from its rim to serve as an additional rib, and the ribs and end stop are preferably uniformly spaced.

In practice it is found advantageous to form the ribs and end stop with effectively undercut side walls so that they are of dovetailed form in cross-section and afford an enhanced key. Also, it is desirable that the ribs other than that nearest the cup rim be formed with transverse gaps or passages to facilitate the flow of cement between the inter-rib spaces. These gaps or passages will, of course, also enhance the key.

Further development of the invention has led to the provision of a preferred form thereof involving a device is discussed above to serve as an outer part in a compound, separable assembly. In this preferred form, a second, generally hemispherical, cup is located within the former as an inner part or liner. This compound assembly is advantageous for several reasons. More conventionally, a single part acetabular cup is used in association with a femoral head, and, apart form the more general question of suitability for use for prolonged duration in the human body, a compromise must be made in the choice of materials in respect of desired strength and bearing characteristics. This severely restricts the overall choice of materials and even then it is common to use a relatively small femoral head size of about 25 mm. diameter to ensure that the acetabular cup wall does not distort. The use of a small

head reduces the range of joint movement for a given femoral head stem and increases the risk of dislocation.

In the development under consideration, the provision of a two-part cup assembly permits different materials to be chosen for the cup and liner to better suit the requirements of fixation and strength on the one hand, and friction and attrition with the femoral head, while affording shock absorption on the other hand. In the result, it is possible to use a larger femoral head giving a greater range of movement and increased stability. Also, it will be clear that the inner cup or liner can be replaced, if necessary, without requiring extraction and re-fixation of the outer cup or femoral head stem.

For a fuller understanding of the invention as so far described, the same will now be described by way of example with reference to the accompanying drawings, in which:

FIGS. 1 and 2 are respective plan and side views of an embodiment of the invention,

FIGS. 3 and 4 are sectional views taken on III — III and IV — IV in FIG. 1, respectively.

FIG. 5 is a sectional view of such an embodiment when implanted, and

FIG. 6 is a sectional view of a further embodiment of the invention.

In the drawings, the cup 1 is formed with three ribs 2, 3 and 4 and an end stop 5. The side walls of the ribs and end stop are each defined by rotation of a radius of the cup, the relevant radius being at a different angle to the cup axis for each rib and end stop side. Putting this another way: the relevant side walls are in the form of coaxial, frusto-conical surfaces defined with reference to a common origin or apex. In this connection it is to be noted that the cup is substantially hemispherical apart from the rim part adjoining rib 2, which part is first cylindrical and then outwardly chamfered at 15. The result of this formation is that the ribs 3 and 4, and the end stop are of dovetailed transverse section.

Rib 3 is formed with two diametrically opposed gaps 6 in order to promote the flow of cement as noted above.

Also, ribs 3 and 4 and the end stop are provided with grooves 7 lying in a common diametral plane which is perpendicular to that of the gaps 6. The grooves 7 define a seat for a semicircular wire 8 with inwardly turned end portions 9 which are received in bores 10 adjacent rib 2. This wire and its seating are desirable so that the position of the device and its relationship with an associated femoral head can be assessed radiographically at various stages after implanting. This assumes that the device is to be made of a material which would not otherwise by suitable for such examination.

Turning to this question of materials, it is currently proposed that the device be made of RCH.1000 high molecular weight polyethylene or carbon-filled RCH.1000, and that the trace wire be of cobalt-chromium alloy. However, any other suitable materials may be employed be they plastics, metals, ceramic or composite materials.

A further consideration is that of dimensions. It is proposed that the present device be made in three standard sizes I, II and III for which the detailed dimensions, denoted by reference letters in the drawings are given below:

	I	II	III
A	10	10	10
B	1.1	1.1	1.1
C	45°	45°	45°
D	1.5	1.5	1.5
E	3	3	4
F	3	3	4
G	3	3	4
H	19.5	22	22.5
J	25.2	25.2	35.2
K	45	50	57
L	20°	20°	20°
M	28°	28°	28°
N	48°	48°	48°
O	56°	56°	56°
P	78°	78°	78°
Q	1.1	1.1	1.1
R	3	3	3
S	1.5	1.5	1.5
T	19.5	22	25.5
U	1.5	1.5	1.5
V	3	3	3
W	1.1	1.1	1.1

These dimensions are given in mm. except where otherwise denoted as angles.

FIG. 5 shows a device as just described, when implanted with cement 11. In this connection, the acetabulum may be prepared by using a gouge to roughen the acetabulum and drilling several divergent holes, or by reaming with a hemispherical seamer and drilling three large holes in the ischium, pubis and ilium. These preparations allow some flexibility for the surgeon in catering for different conditions.

FIG. 6 illustrates in a sectional view similar to that of FIG. 3, an embodiment of the preferred form of the invention discussed above. The outer cup is denoted at *1a* with ribs *2a*, *3a*, *4a* and an end stop *5a*. This cup is similar to that of the first embodiment apart from the following differences. The rib *2a* adjacent the rim will normally be circumferentially thicker than the rib 2 insofar as this is necessary to retain cup strength in the presence of the annular groove 11 provided in the cup inner surface adjacent the rim. The cup *2a* has no chamfer similar to that at 10. Also, the cut *2a* will normally be made of metal, suitably cobalt-chromium alloy or titanium, for high strength and, in this event, there is no requirement for the grooves 7 to seat a radiographical trace wire.

The inner cup is denoted at 12, and is of hemispherical form dimensioned to fit within the outer cup where it is retained by a spring circlip 13 seated in he groove 11. This inner cup will normally be of a plastics material, suitably RCH.1000 polyethylene, to afford good bearing characteristics in association with a metal femoral head.

The currently proposed dimensions for an embodiment such as that of FIG. 6 are as follows:

D' 3, E' 4.5, K' 50, J' 42
J'' 35, X 43.8, Y 38.2, Z 1.6

These dimensions are given in mm., and the remaining angular dimensions in connection with the ribs and end stop are as for the first embodiment.

We claim:

1. A prosthetic acetabular device, comprising:
a cup having hemispherical inner and outer surfaces and a circular rim joining said surfaces;

a plurality of annular ribs each extending from and circumscribing said outer surface parallel to said rim, and including one such rib bordering said rim;
a disc form end stop extending from that part of said outer surface most remote from said rim, said stop having an annular edge disposed parallel to said rim;
each of said ribs and said stop being formed integrally with said cup and extending therefrom substantially uniformly;
said ribs and said stop being uniformly mutually spaced to define grooves therebetween having significantly greater transverse dimensions than said ribs;
and each of said ribs except said one rib being formed with a plurality of transverse passages therethrough and uniformly spaced therearound to communicate neighboring ones of said grooves.

2. A prosthetic device for use as a bone joint socket replacement, which device is designed to be used together with a self-hardening or self-curing gap-filling agent within a cavity cut in the bone at the joint socket, said prosthetic device comprising:
a cup-shaped member having a substantially hemispherical inner surface, a substantially hemispherical outer surface, and a circular rim joining said surfaces; and a plurality of annular ribs extending from and circumscribing said outer surface parallel to said rim and including one such rib bordering said rim;
said ribs extending from said outer surface substantially uniformly to ensure a sufficient spacing of said outer surface from said cavity to accommodate a desired thickness of said gap-filling agent therebetween;
said ribs being mutually spaced to define grooves therebetween having significantly greater transverse dimensions than said ribs to ensure that a major proportion of said outer surface area is bonded to said cavity by said gap-filling agent;
said ribs being integrally formed with said member and having side faces extending radially relative to the hemispherical center of said outer surface to afford dovetail transverse sectional shaping for said ribs to ensure enhanced bonding with said gap-filling agent;
and each of said ribs except said one rib being formed with a plurality of transverse passages therethrough and uniformly spaced therearound to communicate neighboring ones of said grooves and ensure uniform distribution of said gap-filling agent.

3. A device according to claim 2 comprising a disc form end stop extending from that part of said outer surface most remote from said rim, said stop being similar to said ribs in that it extends uniformly and integrally from said outer surface, it has an annular periphery disposed parallel to said rim, it has a side face extending radially relative to said center, and it is spaced from the next adjacent one of said ribs to define an additional one of said grooves.

4. A device according to Claim 2 made of plastic non-radiographically opaque material, wherein said ribs are transversely grooved in a radial plane symmetrically disposed relative to said inner surface, and com-

prising an arcuate member of radiographically opaque material received in said grooves.

5. A device according to Claim 2 made of metal and comprising a substantially hemispherical liner cup of plastic material dimensioned to seat in said inner surface, said inner surface having an annular groove therearound parallel to and adjacent said rim, and a spring circlip received in and projected from said groove to retain said liner cup seated in said inner surface.

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